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POPULATIONS AS A FACTOR IN PREDICTING IPS CONFUSUS OUTBREAK

P 2

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for
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WKC

April 22, 1952

To: Dr. J. A. Beal, In Charge, Forest Insect Investigations
Beltsville, Maryland

From: F. P. Keen, In Charge, Forest Insect Laboratory, Berkeley

Subject: Ips population studies

We are enclosing a copy of a recent report prepared by George Struble on the results of 1951 seasonal studies continued on Ips confusus. In this study an attempt was made to determine the importance of populations breeding in spring and early summer accumulations of slash resulting from logging, in predicting subsequent outbreaks in reserve ponderosa pine stands. Struble found that despite heavy mid-seasonal population yields, although somewhat less than anticipated from examinations early in the season, there was no apparent relationship with subsequent attacks in any of six areas studied. The reason for this was attributed to a general improvement in stand resistance following the wettest winter since 1938.

These results point out the importance of information, both on climate and populations, as a basis for predictions which may be used in practices to prevent outbreaks, especially during dry periods.

cc: Furniss
Evenden
Orr
Wygant

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POPULATIONS AS A FACTOR IN PREDICTING *IPS CONFUSUS* OUTBREAKS

Progress Report - Season of 1951

By

George R. Struble
Entomologist

Submitted By:

Approved By: George R. Struble, Entomologist

F. P. Keen, In Charge

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Berkeley 4, California
April 10, 1952

POPULATIONS AS A FACTOR IN PREDICTING *IPS CONFUSUS* OUTBREAKS

Progress Report - Season of 1951

INTRODUCTION

Biological and ecological studies of *Ips confusus* Lec. in ponderosa pine over the past several seasons in the California pine region have indicated repeatedly that the number of successfully reared adults emerging from a given slash area during midsummer is an important factor in determining whether reserve stands will be subsequently attacked and killed. They indicated also that adult populations did not act alone, but were dependent upon a combination of factors probably affecting host tree resistance, among which climate, and especially seasonal precipitation, seemed to be most significant. Consequently, both precipitation and populations are looked upon as good indicators of outbreaks when in the right combination. This combination has not as yet been determined, but studies are being pursued, the results of which should be useful as a basis for predicting outbreaks and acting at the right time with measures to prevent them.

In the most recent study of these factors, an attempt was made to determine the significance of mid-season populations as killers. It was started early in June 1951, and continued for 2½ months, the period during which subsequent killing in reserve stands occurs most frequently. In setting up this study it was necessary, as in the past on this problem, to depend on logging slash areas having qualifications acceptable for study purposes on the points to be determined. Six areas were found which came reasonably close to meeting requirements, in and adjacent to the Sierra National Forest, where climatic factors applicable to these areas could be used along with population studies in the interpretation of results. These are described in detail by Table 1 (Appendix).

PROCEDURE

The data requirements were similar in all areas studied, with basic information on: (1) number and size of trees cut; (2) bark surface conducive to *Ips* breeding; (3) number of mature progeny; (4) number of merchantable size and pole-size trees in reserve; (5) amount of subsequent killing in reserve; (6) influence of precipitation.

The procedures adopted in securing this information relied on sampling which included close to 10-percent of the slash and reserve in each area. For example, in the McSwain area of 80 acres (Photo 1), eight representative one-acre units were sampled completely for bark surface, number of reserve trees, and population data. The amount of killing subsequently occurring in reserve trees included the total within the entire cutting area.

Population samples were made on the basis of the number of mature progeny occurring in representative 36 square-inch areas of inner bark surface on top, sides, and bottom of unlopped tops lying on the ground at each 10-foot interval from the base to a 3-inch diameter. In other words, top sections having a 30-foot length to a 3-inch diameter usually required samples from 2 to 3 areas. With a 36 square-inch unit on top, bottom, and sides, a total bark surface of one square foot was taken at the location selected for samples.

An innovation in sampling technique was the measurement and removal of each bark section to a tightly closed paper bag, following the count of loose and crawling brood. This allowed for the collection of a large number of samples which were placed under refrigeration until complete counts could be made, and resulted in a considerable saving in the time required.

CHARACTER AND AMOUNT OF SLASH AND RESERVE IN STUDY AREAS

With the exception of the slash in the Hendrickson logging area (Photo 2), all other material included in this study consisted of unlopped top sections which lay scattered in varying degrees of concentration over each cutting area. The Hendrickson slash (Photo 2) was lopped in accordance with requirements written into the logging contract, and hence much of the breeding surface (at least 60 percent) was rendered unsuitable for breeding. However, the large amount of slash within the 800-acre Hendrickson area conceivably may have tended to compensate for the surfaces rendered unfit for breeding, with the possibility that killing populations could still be produced.

The number of trees cut, amount of slash suitable to the rearing of Ips, and reserve stand left in each of the study areas is shown by Table 1. These figures give a fairly clear picture of the variations as to intensity of cut, density of stand, and relative concentrations of slash. In the Hadley area for example, breeding surface per acre amounted to less than 1/4 of that in the Vaughn area, while the reserve stand in the Hadley area was only 1/20th of that in the Vaughn area. Thus in some areas such as Vaughn, McSwain, and Early Mine, the concentrations of slash suitable to breeding in a small area would appear as a greater hazard to the reserve than lesser amounts.

NUMBER OF IPS ADULTS REARED

The adult populations emerging within the slash study areas as estimated from the samples taken are shown by Table 2. Variations in number reared per unit of bark surface ranged from 50 to 125 per square foot, with an average for all areas of 93 per square foot. This is somewhat less than the numbers anticipated from early seasonal examinations of immature broods. However, within any given slash area the total emergence was judged large enough even in the areas

of least emergence to be a threat to the reserve stand if such stands were in a non-resistant state.

It is to be noted that the least emergence per acre in any of the areas, namely Hendrickson, was about 1/11th of that in the area of heaviest emergence per acre (Vaughn area).

ATTACKS IN THE RESERVE STAND

The relatively higher concentration of adults in the Vaughn area, as well as in all the other areas (Table 2), indicated the possibility of differences in the degree of subsequent attacks made on reserve stands in the vicinity of cutting areas. Such differences were not evident in the degree indicated by population differences in the fall surveys that were made of these areas 1/, as shown by Tables 3 and 4.

The killing of reserve trees in these cutting areas as revealed by fading and faded trees, by October 15 is interpreted as probably the maximum number affected by adults breeding directly in the slash, and which emerged completely by mid-August in some of the areas. Fades subsequent to October 15 in the McSwain area are believed to have resulted from attacks made after mid-September from an unknown source, from those which may have held over in reproduction and poles attacked earlier, or from new progeny adults which were reared in earlier, top-killed trees within the area.

The amount of killing in reserve stands resulting directly from adults reared in the slash, even under the most favorable circumstances of high populations was insignificant in the areas studied in 1951. The reasons are none too clear, but point to probable host resistance brought about through general increased precipitation during the winter 1950-51 which was one of the highest for many years. An examination of records representative of the areas studied, shown in Table 5, reveals a high total for each station and a spring rainfall believed sufficiently high to sustain reasonably good growth conditions throughout the dry summer period. The average precipitation for 7 stations varying in elevation from 2,700 to 4,600 feet was 42.42 inches. This is an average departure from normal of + 9.47 inches.

SIGNIFICANCE OF RESULTS

The information obtained from these records does not offer conclusive evidence on either the importance of populations or of climatic factors. It shows simply that at least for the 1951 season,

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1/ Past records have shown considerable subsequent kill showing up as fading trees during the winter and spring months.

populations were sufficiently high in slash to have resulted in late summer and fall outbreaks in reserve stands, but improved stand resistance resulting from increased moisture in the soil probably prevented more than a light killing in most cases.

These results tend to lend considerable support to seasonal predictions that might be made as to whether or not an Ips outbreak will occur in reserve stands, but they hold true only when slash conditions have allowed a high population up-build by mid-summer. If, as it frequently happens, that broods established early in the season do not result in more than a low yield of adults, then no outbreak can occur even though the resistance factors of a stand are greatly weakened.

It is for these reasons that, even with the background of information acquired on the problem thus far, there is still much more to be learned about the facts before accurate recommendations on practices based on seasonal prognostications can be made. Knowledge of climatic, as well as biological and ecological factors affecting both the host tree and the adult population potential are essential as a substantial basis for accurate predictions. Studies continued on this problem should, therefore, not minimize the importance of any one.

TABLE 1. - DESCRIPTION OF STUDY AREAS

Name & Location	Cutting Date	Acres	Elev.	Amount of Cut			Amount of Reserve			Breeding Surface Square Feet	
				Trees	Volume Bd. Ft.	Trees/Ac	Trees	Volume Bd. Ft.	Trees/Ac	Total	Per Acre
McSwain, Madera Co.	2/15 to 6/1/51	80	2,800	1,840	500,000	23	5,000	200,000	63	105,500	1,320
Hendrickson, Mariposa Co.	4/2 to 6/10/51	800	2,500	16,000	1,500,000	20	28,000	1,120,000	20	260,000	325
Teaford, Madera Co.	6/5 to 15/51	40	3,000	600	300,000	15	2,800	200,000	70	33,500	840
Vaughn, Fresno Co.	6/5 to 6/1/51	160	4,500	4,000	800,000	25	9,600	480,000	60	300,000	1,965
Hadley, Mariposa Co.	6/10 to 7/7/51	40	3,000	400	200,000	10	490	40,000	12	19,550	480
Early Mine, Mariposa Co.	6/15 - 20/51	15	3,500	225	25,000	15	1,050	50,000	70	16,000	1,060

TABLE 2. - NUMBER OF IPS ADULTS REARED FROM SLASH AND AMOUNT OF KILLING IN RESERVE STANDS

Cutting	Number of Adults		Number of Trees Killed				
	Total	Per Acre	Merchantable Size				Poles
			Total		Percent of Stand		
			Trees	Vol. Bd. Ft.	Trees	Vol. Bd. Ft.	
McSwain	12,132,960	151,670	13	2,100	0.25	1.05	30
Hendrickson	13,000,000	16,250	14	1,800	0.05	0.15	14
Teaford	3,851,580	96,000	16	2,400	0.57	1.20	8
Vaughn	27,000,000	176,850	10	2,300	0.10	0.47	2
Hadley	1,646,000	32,300	0	0	0.00	0.00	0
Early Mine	2,000,000	133,375	0	0	0.00	0.00	15

TABLE 3. - NUMBER OF IPS ADULTS COMPARED TO SUBSEQUENT TREE MORTALITY

Area	Total Ips Adults (Millions)	Number of Trees Killed		
		Trees	Poles	Total
Vaughn	27.0	10	2	12
Hendrickson	13.0	14	14	28
McSwain	12.1	13	30	43
Teaford	3.8	16	8	24
Early Mine	2.0	0	15	15
Hadley	1.6	0	0	0

TABLE 4. - NUMBER OF RESERVE TREES COMPARED WITH KILL

Area	Number Trees & Poles	Number Trees & Poles Killed
Hendrickson	28,000	28
Vaughn	9,600	12
McSwain	5,000	43
Teaford	2,800	24
Early Mine	1,050	15
Hadley	490	0

TABLE 5. - PRECIPITATION DATA JULY 1, 1950 TO JUNE 30, 1951 IN INCHES

Station	Elev.	Tot. Precip.	Departure 1/	Spring Precipitation				Cutting Area Represented
				March	April	May	June	
Bass Lake	3300	46.54	(+11.50)	2.18	3.58	1.02	.20	McSwain, Teaford, Early Mine
North Fork	2900	39.39	+5.75	1.47	2.73	.50	.00	
Ahwahnee	2700	35.00+	(+4.00)	1.95	2.15	.40	.00	Hadley, Hendrickson
Pine Ridge	4600	43.31	(+9.50)	4.30	3.72	.50	T	Vaughn
Pinehurst	4100	39.32	(+6.50)	1.36	4.21	.36	.07	
South Entrance	5200	55.30	(+14.30)	2.34	3.79	1.85	.61	
Yosemite Valley	4100	46.61	+12.75	2.57	3.51	.88	.75	
Groveland	3700	46.16	(+11.50)	2.53	2.51	1.48	.23	
AV.		42.42	(+9.47)	2.34	3.28	.87	.23	

1/ Figures in parentheses approximate, based on North Fork and Yosemite Valley records.

Photo 1 (3211) McSwain Cutting Area.

Lower and right middle foreground show stand character following cutting

Photo 2 (3212) Accumulation of logs and lopped tops characteristic of Hendrickson cutting area.